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ABSTRACT

Four experiments investigating the effects of physical and social variables on the production of pointing in infants 10 to 18 months old are described. In the first two experiments, which were primarily concerned with the relation between reaching and index finger pointing, physical dimensions such as distance between baby and target objects were manipulated. Vocalization and the social communicative intentions of the pointing babies were measured. The third and fourth experiments concerned the role of the social context on the production of the pointing gesture. The third experiment compared the incidence of pointing in the presence and the absence of the mother in order to determine whether production of the gesture by the infant implies a recipient of the message. The fourth experiment compared the incidence of pointing in babies when the mother was the partner with the incidence of pointing when another infant was present. Results supported the view that pointing is, from its inception, a form of shared reference. An intrinsically social gesture, it is associated with visual checking with the social partner. It is used in infant-to-infant interaction and is not produced if there is no one around. Findings are discussed in terms of an early capacity of sharing reference and certain aspects of social understanding shown by infants. (RH)

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INFANT POINTING: PRELINGUISTIC REFERENCE AND CO-REFERENCE

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Infant pointing: prelinguistic reference and co-reference.

ABSTRACT

The aim of this study was to investigate the effects of physical and social variables on the production of pointing in infants 10 to 18 month old. Three experiments are presented, the first two manipulating physical dimensions such as distance between baby and target objects, and the third one manipulating social dimensions such as presence/absence of a social partner; some preliminary illustrations from a fourth study with infant agemates are also presented.

Results support the view that pointing is a form of shared reference from its inception. Moreover, pointing appears an intrinsically social gesture as it is associated with visual checking with the social partner, it is not produced if there is nobody around and is used in infant-infant interaction.

The experiments are discussed in relationship to an early capacity of sharing reference and some aspects of social understanding showed by infants in this study.

INTRODUCTION

There is no disagreement that the literal, or **explicit** "meaning"of pointing is a directive for someone else's attention, ie. "look at that". However, there are at least three discriminable theories of the **implicit** "meaning"of the gesture. Millicent-Shinn (1900 quoted in Schaffer 1984) argued that index finger pointing is an extension to distal targets of the finger tip exploration of objects. Such an exploratory function, when performed in a social context would have an interrogative or information-seeking implicit meaning.

By contrast, Werner and Kaplan (1963) claimed that the implicit meaning of pointing is pure reference, i.e. it is an act of isolation of a target against a background which eventually develops into specific identification by means of a verbal label. In functional terms, the gesture's implicit meaning, is that of sharing interest in a target. On this theory pointing has a declarative function.

A third point of view, by Vygotsky (1962) claims that pointing is fundamentally an instrumental gesture; it is somehow an intermediate step between direct attempts to grasp a desired object and gaining a desired object from a social partner by symbolic (verbal) means. On Vygotsky's theory pointing has an instrumental, or imperative, implicit meaning.

These theories offer different hypotheses about the origins of pointing as well as about the role and response of the addressee of the pointing gesture. They make different predictions about the relationship between pointing and request gestures such as reaching. Vygotsky hypothesises that in development pointing substitutes for reaching (the

act of pointing has the same function as reaching and is developmentally derived from it) whereas for Werner & Kaplan pointing and reaching do not bear any relationship to each other (the acts have different functions and different origins). One of the main aims of this research is to find out more about the relationship between reaching and pointing.

We will argue that two features of pointing may offer a first approach to capturing its special status for human communication development. (i) It reveals elements of social awareness in young infants who are attempting to communicate , and (ii) It reveals rather complex planning and intercoordination of sequences of actions (vocalisation, social checking and manual pointing) involved in early communication which may differentiate sub-systems implicated in its ontogeny.

We report four experiments carried out to find out more about these issues. The pilot experiment 1 and experiment 2 were primarily concerned with the relation between reaching and index finger pointing. These studies also measured vocalisation and the social communicative intentions of the pointing babies. The third and fourth experiments considered the role of the social context on production of the pointing gesture. In experiment 3, we compared the incidence of pointing in the presence or absence of the mother, to establish whether production of the gesture by the infant implies a recipient of the message. This is a test of the communicative intent of the newly pointing infant. In a fourth experiment, we compared the incidence of pointing in babies when the mother was the partner (an asymmetric relation in terms of the cognitive and communicative competence of the infant), with the incidence of pointing when another infant was present (a symmetric communication relationship). In this way we hoped to establish whether

pointing by the infant depends in any way on the availability of differential feedback from the social partner.

GENERAL METHOD

Some features of the experiments were constant. The laboratory layout is shown in Fig.1.

Figure 1

These seating arrangements were adopted for experiments 2,3 and 4 (in the pilot study the infant sat in the corner of the room). The infant sat in a high-chair and the mother next to her/him (at 90 degrees). All sessions were videotaped using split screen videorecording to yield a general view of adult and infant and a close up of the baby. The recordings were subsequently analysed according to a specially developed coding system. Purpose built remotely controlled dolls, a radio controlled model car and two attractive stationary toys were used to elicit pointing and reaching gestures from infant.

In the studies comparing **reaching and pointing** gestures (experiments 1 and 2) the physical context was varied. The remotely controlled moving doll figures were placed at a constant distance from the baby (268 cms); or a radio controlled car moved from a position near the infant to a position close to the stationary dolls; or the two attractive toys were presented on a table just out of reach of the baby. The sessions were presented in a systematic order, each lasting 3'30". The position of the mother (to the left or right of the baby) was counterbalanced.

In the studies of the **social conditions for pointing** (experiments 3 and 4) presence or absence of the partner and the degree of her involvement in the interaction were manipulated. The sessions were again of 3'30" duration but only the moving dolls were presented to the babies. These were activated either singly or in pairs in an irregular sequence. Experiment 3 compared pointing when the baby was alone (**M**other and **E**xperimenter left the room or were not visible to the baby); pointing by the baby when the adult was passive (M and E present and visible but not gesturing); and when the adult was active (M and E present, E pointing at pre-established times). In experiment 4 the baby was tested with an agemate and then with the mother, again in sessions lasting 3'30", with the moving dolls.

Subjects The age range of subjects was 10 to 24 months; pointing is generally reported to emerge at 12-14 months. Subjects were volunteers recruited in the Stirling area.

EXPERIMENTS 1 AND 2

Experiment 1 was concerned with the origins of pointing in babies. Three separate types of contexts were compared with respect to the production of pointing and reaching gestures:

1. **Distal context**: Two remotely controlled doll figures on pedestals 120 cms tall were placed in front of the baby at 268 cms distance; they were stationary or moving (their arms and legs going up and down in a 7 secs. cycle of motion with 7 or 15 secs. between cycles) either singly or in pair according to a pre-established sequence;

2. **Proximal context**: Two attractive toys (a telephone and a musical toy) were

demonstrated by the experimenter and then left on a small table just out of reach for the baby;

3. **Distal-Proximal context**: A radio-controlled car was stationary or moving between pre-established positions (i.e., the car stopped next to the dolls, or just next to the high-chair). Fig.2 shows the target objects.

Figure 2

The experiment allows us to check whether there are "privileged" contexts for the gestures, and whether in any of the contexts, or all, a developmental sequence can be observed where reaching precedes pointing. In this first experiment we used the three contexts in a fixed order with 22 babies, whereas in a second experiment we used, in counterbalanced order, the contexts which proved to elicit more gestures, i.e., the far dolls and the out-of-reach toys, with 29 babies.

Briefly, the results of these first two studies show that the gestures typically produced are pointing with the far dolls and reaching with the out-of-reach toys (Fig. 3). Virtually no reaching is addressed to the dolls whereas pointing is also addressed to the toys (for further details see Franco and Butterworth, 1988, 1989).

Figure 3

Thus, pointing and reaching are differentiated by context. How does this relate to the social functions of communication?

If the function of pointing is that of sharing attention to a referent, the infant must

check that her message has been received. We therefore hypothesised that the referential, declarative nature of pointing would show in the coordination of the gesture with visual checking of the social partner. Moreover, the pattern of visual checking may be different in declarative gestures such as pointing, and requestive, imperative gestures such as reaching.

We analysed the occurrence of looks to the social partner associated with pointing and reaching gestures. The analysis of the distribution of gestures accompanied by looks within a time window from 2 sec. **before** gesture intiation, the time **during** gesture execution and 2 sec. **after** gesture completion showed the results presented in Figs.4 and 5.

Figure 4

These data concern only the first look occurring, either before, during or after the gesture. At 12 mos., infants typically look at the partner **after** pointing; at 14 mos., infants manage to turn and look at the partner **during** the point; and by 16 mos. they look at the partner **before** initiating the point. It is as if they are checking if the partner is attending to their point and that their message has been received.

Figure 5

The pattern is different for reaching, where infants typically look at the social partner during gesture execution. If we consider the proportion of gestures associated with **multiple checking**, i.e., when the infant looks at the partner on more than one occasion (e.g. during and after gesture), again the developmental pattern for pointing and reaching

is remarkably different.

Figure 6

Fig. 6 shows that the proportion of reaching characterized by multiple checking is lower and stable across age, whereas the capacity to look at the partner at different times in the sequence of the gesture linearly increases with age in the case of pointing.

On the whole, the development of the checking behaviour associated with pointing may show the achievement of some "metacognitive" awareness that the social partner must be attending to receive the gesture and, consequently, to be able to share reference with the baby (Franco and Butterworth, 1989).

As we have seen, the initial, more common locus of checking at 12 mos. is immediately **after** pointing. This temporal framing (gesture, then look to partner) resembles that of social referencing, where the infant observes an event, and then looks at mother: in both cases, the function of the look is to share feelings or seek information. It is still possible to hypothesise that pointing itself is not social, but just a manifestation of the infant's attention/orientation, as it were, externalised. The look **after** pointing could have occurred as isolated social referencing, independently of the gesture.

Some analyses we carried out on a group of 10 month olds may be illuminating with respect to this question. Fewer 10 month olds pointed in our laboratory setting and with remarkably lower frequencies than 12 month and older babies. Nonetheless, 10

month old babies mainly look at the partner **after** pointing, just as the 12 month group. However, there is a striking difference in the amount of pointing addressed to the targets and to the social partner.

Figure 7

The data presented in Fig. 7 concern points addressed to the dolls or toys (target) and the points addressed to the partner or the lights, cameras etc. (non-target). Virtually all non-target points by the 10 month olds are oriented to the adult, whereas most non-target points by the older babies are oriented towards aspects of the room. The graph shows that at 10 months infants point equally often to the adult as to the targets, whereas older babies are mainly oriented to the target objects. What happens here is seen only in the 10 month olds: after watching the dolls they turn to **look and point at the social partner**; then they go back to look at the target. As their attention starts from, and returns to the target, their pointing is obviously target-related - but, as it were, it "follows the eyes". In other words, there seems to be a failure to differentiate two actions having different purposes and referents, i.e., to establish reference to the target (i.e., pointing), and sharing with the partner (i.e., look) seem to melt into one action -look and point to the partner. In spite of this difficulty, we can however conclude that pointing is already for somebody else.

EXPERIMENT 3

The referential and social nature of pointing is confirmed by a third experiment in which we varied the degree of social presence in the more declarative, referential context

(distal dolls). 57 infants between 12 and 19 mos. were randomly assigned to one of the following conditions:

1. **baby alone**, where mother and experimenter disappeared behind a curtain, and the baby was left alone to watch the dolls;
2. **passive adults**, where mother and experimenter were with the baby watching the dolls; they were socially responsive, but would not take any initiative towards the dolls and would not gesture;
3. **active adults**, where, in the same situation as the previous one, the experimenter would point to the dolls at pre-established times.

We analysed the occurrence of gestures and vocalisations in the three conditions.

Figure 8

The results presented in Fig.8 clearly show a dramatic drop of pointing in the Baby Alone condition, independently of age. No significant difference appears between the other two conditions, suggesting that a responsive social partner is crucial for the baby to point, whereas active pointing by an adult does not lead to an imitation effect.

Figure 9

By contrast, Fig. 9 shows that the decline in production of other gestures (e.g. hi, clapping etc.) in the Baby Alone condition is not statistically significant (for further details see Franco and Butterworth, 1990).

Finally, lack of a social partner suppressed pointing, but many babies pointed to the interesting targets as soon as the adults re-entered the room (some examples are presented in Figs.10-11).

Figures 10 and 11

These results suggest strongly that the pointing gesture presupposes a social recipient for the message in the presence of the infant.

Even though there is a tendency for fewer vocalisations to be produced in the Baby Alone condition, only age has a statistically significant effect on vocal behaviour. Results are presented in Fig.12.

Figure 12

More vocalisations and fewer fussy sounds are produced by older infants across conditions. As to the quality of vocalisations, we noticed that many sounds produced in the Baby Alone condition were **calls** such as "mum!". It is tempting to speculate that infants may suppose that their absent mothers cannot see their gestures or the targets, but can hear their voices -a quite correct representation in our curtained room.

EXPERIMENT 4

In the last study we would like to mention, in collaboration with Paola Per ucchini, we tried to understand whether infant pointing relies on a cognitive and linguistic asymmetry between infant and adult.

20 pairs of age-matched infants between 12 and 24 months were tested with the

"dolls" as in the other studies. The data are not yet fully analysed, but there is no doubt that infants do point for an agemate, and in a similar manner to their pointing for an adult. Figs. 13-14 show some examples.

Figures 13, 14

CONCLUSION

This series of experiments shows that pointing is a specialised form of pre-linguistic reference which has its origins in communication contexts where the infant intends to share attention and interest with a social partner.

The intrisically social nature of pointing is highlighted by visual checking with the adult, or even with an agemate. The developmental pattern associating checking with pointing and reaching gestures differs between 12 and 16 months. Checking rapidly acquires an anticipatory quality when associated with pointing, which suggests a fast developing "metacognitive" appreciation of the communication function of pointing. Furthermore, the dramatic decrease of infant pointing when there is nobody to share reference with and the fact that active pointing by the adult does not significantly influence the rate of pointing in the infant, all lead to the conclusion that infant pointing is an intrinsic communication gesture from the outset. In terms of the three theories outlined in the introduction, our results suggest that pointing originates as an act of pure reference (Werner and Kaplan 1963). It has a **declarative** function by which we mean that pointing singles out an object, or some object property, for the attention of a social partner. It does not primarily have the **imperative** function of gaining the object, as suggested by

Vygotsky.

That babies will point for each other shows that referential communication per se does not depend on the presence of language. Our results are consistent with the view that gesture and spoken language are complementary and non-redundant. This is consistent with contemporary "dynamic systems" theory which would postulate that speech emerges from a dynamic coordination between cognitive, gestural and vocal subsystems (Butterworth 1990).

Acknowledgments

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FIG.1

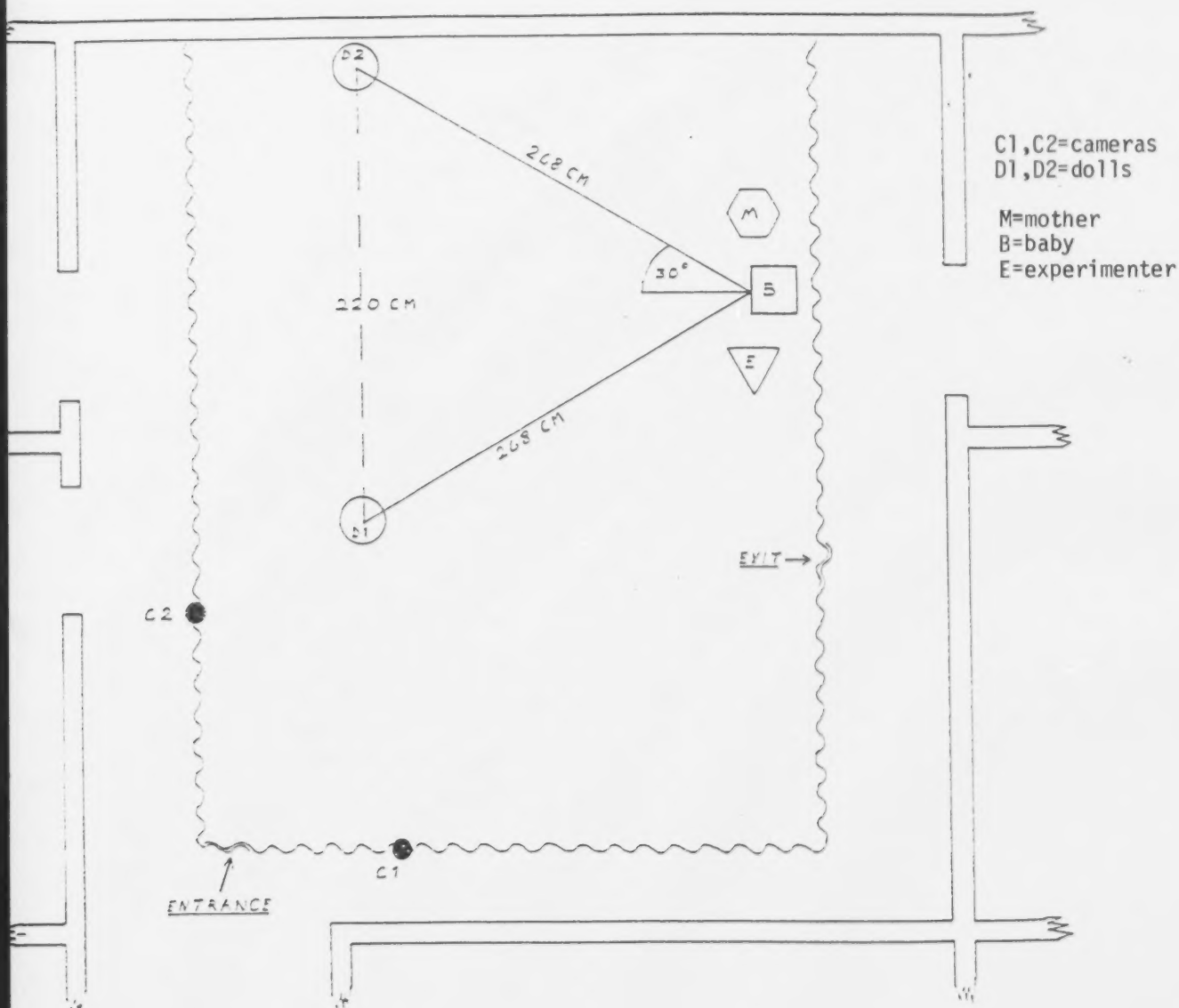
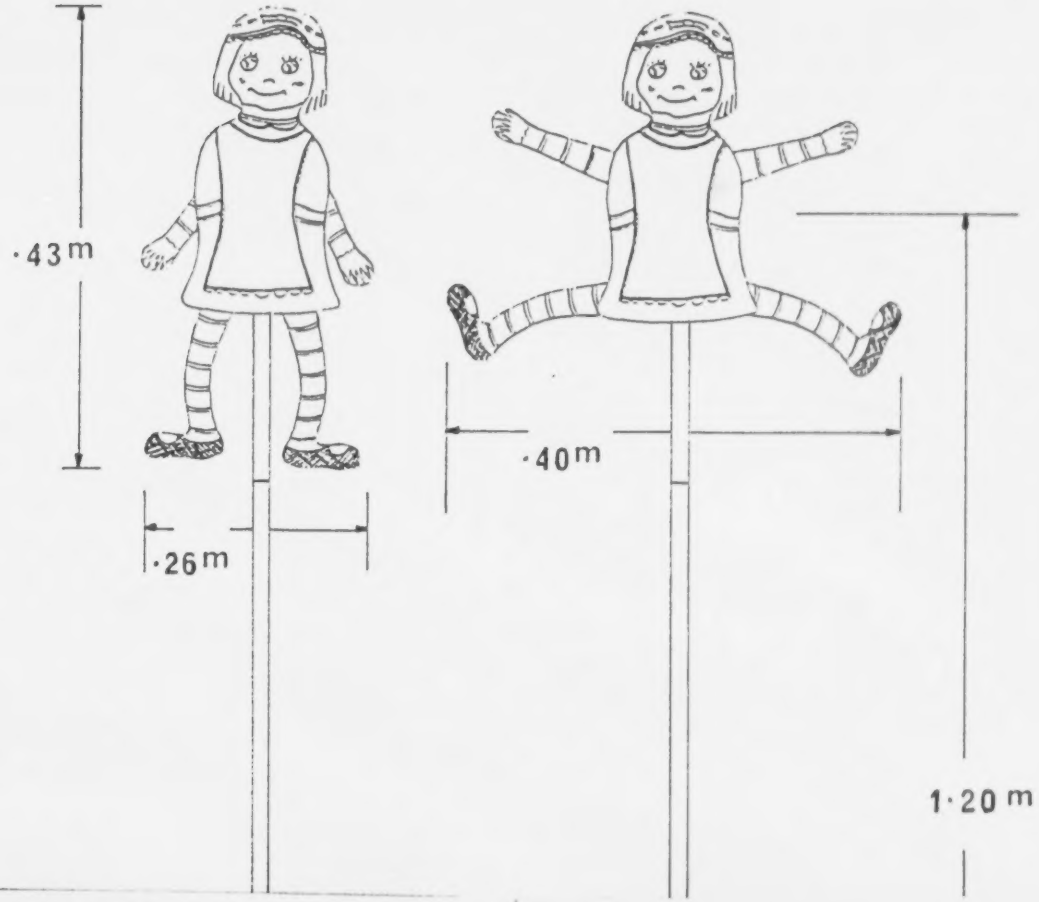
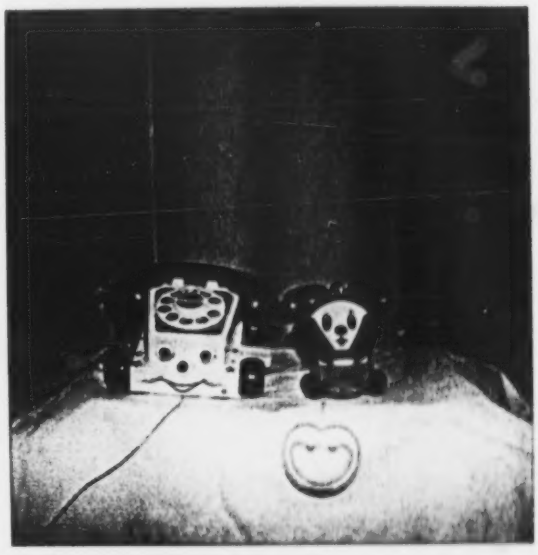

D2
268 CM
30°
M
B
220 CM
E
268 CM
D1
EXIT
C2
C1
ENTRANCE
C1,C2=cameras
D1,D2=dolls
M=mother
B=baby
E=experimenter

Figure 2.
Remotely controlled manikins used in the studies.



CAR



TOYS

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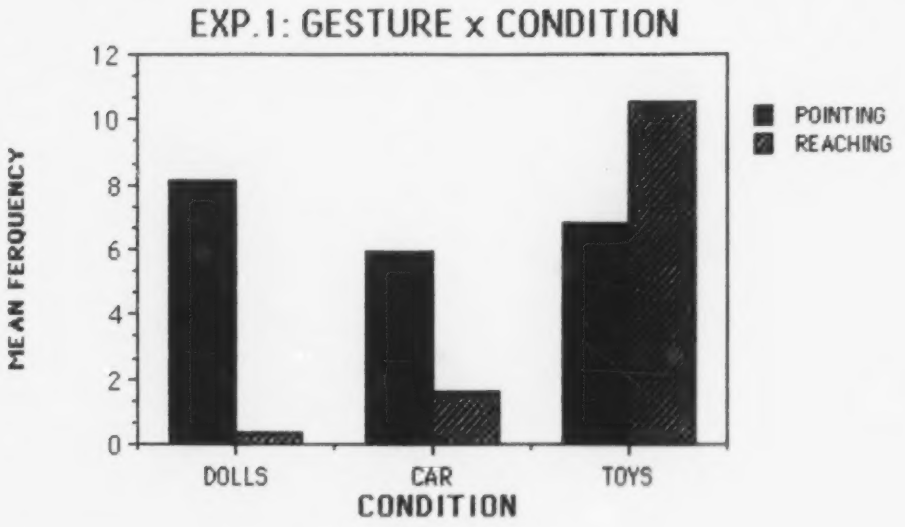
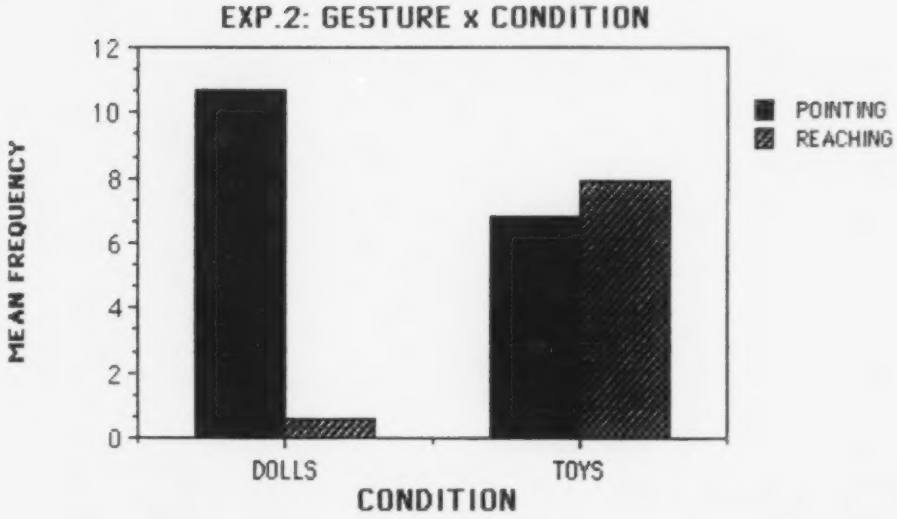
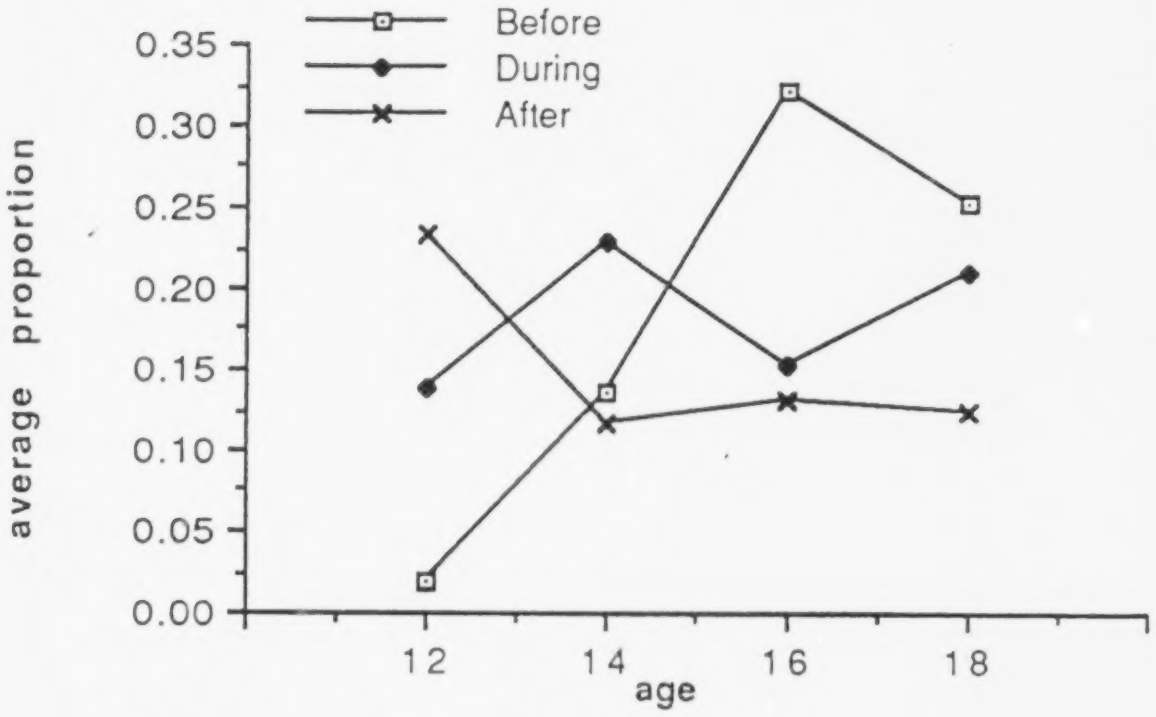
FIG.3


EXP.1: GESTURE x CONDITION
MEAN FERQUENCY
12
10
8
6
4
2
0
DOLLS
CAR
TOYS
CONDITION
POINTING
REACHING


EXP.2: GESTURE x CONDITION
MEAN FREQUENCY
12
10
8
6
4
2
0
DOLLS
TOYS
CONDITION
POINTING
REACHING

FIGS 4 & 5

POINTING



REACHING

FIG. 6

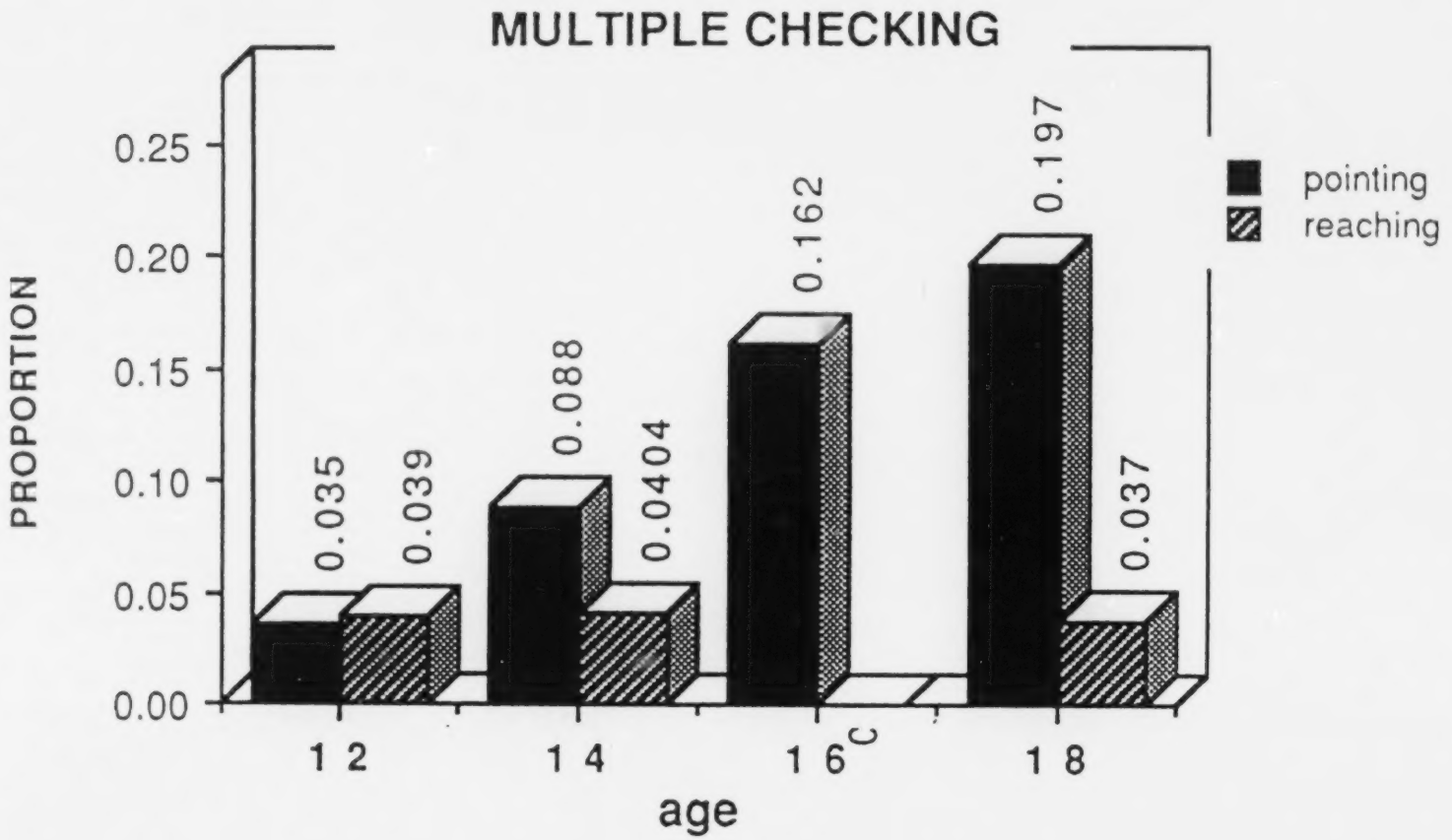
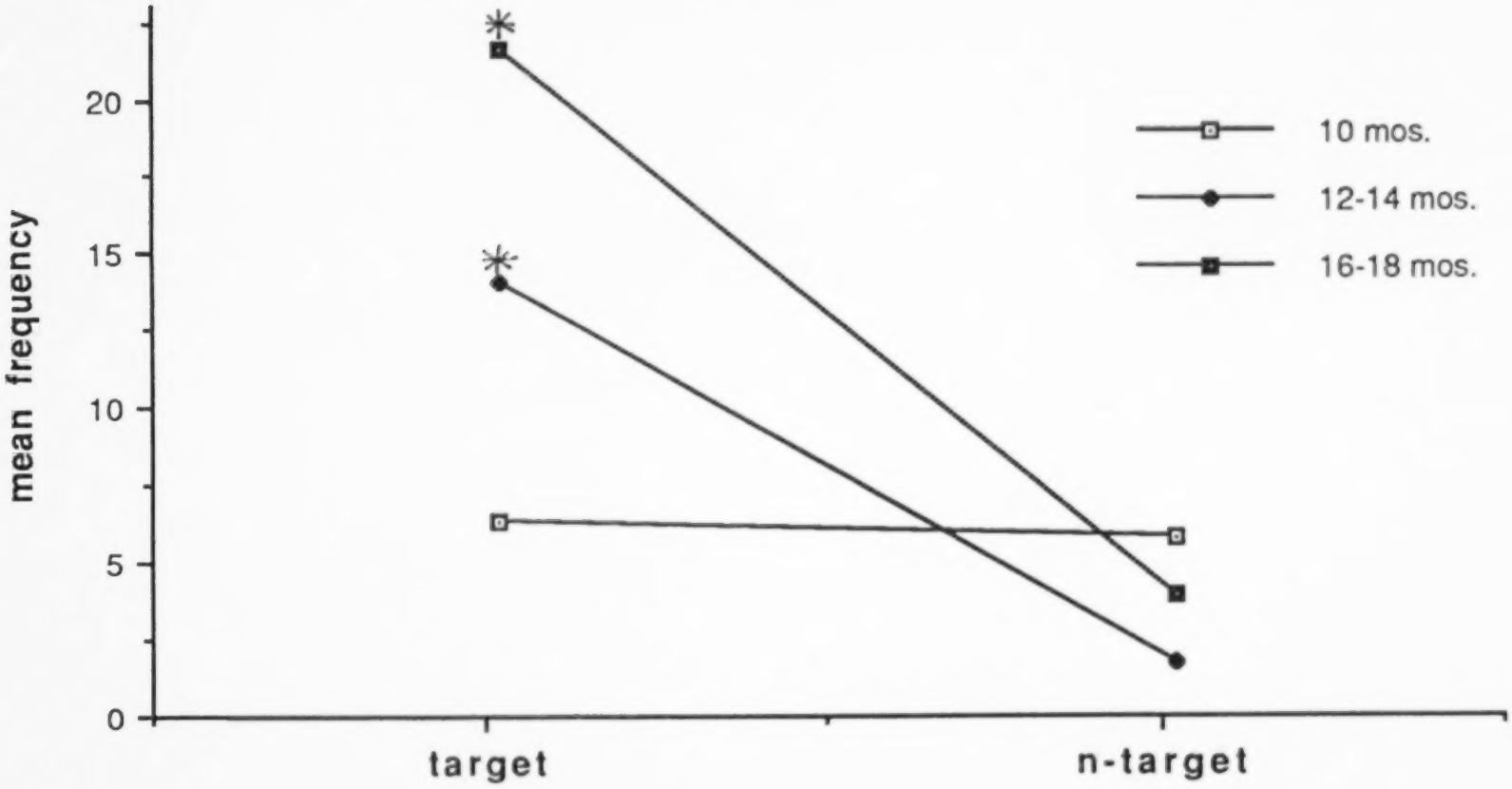
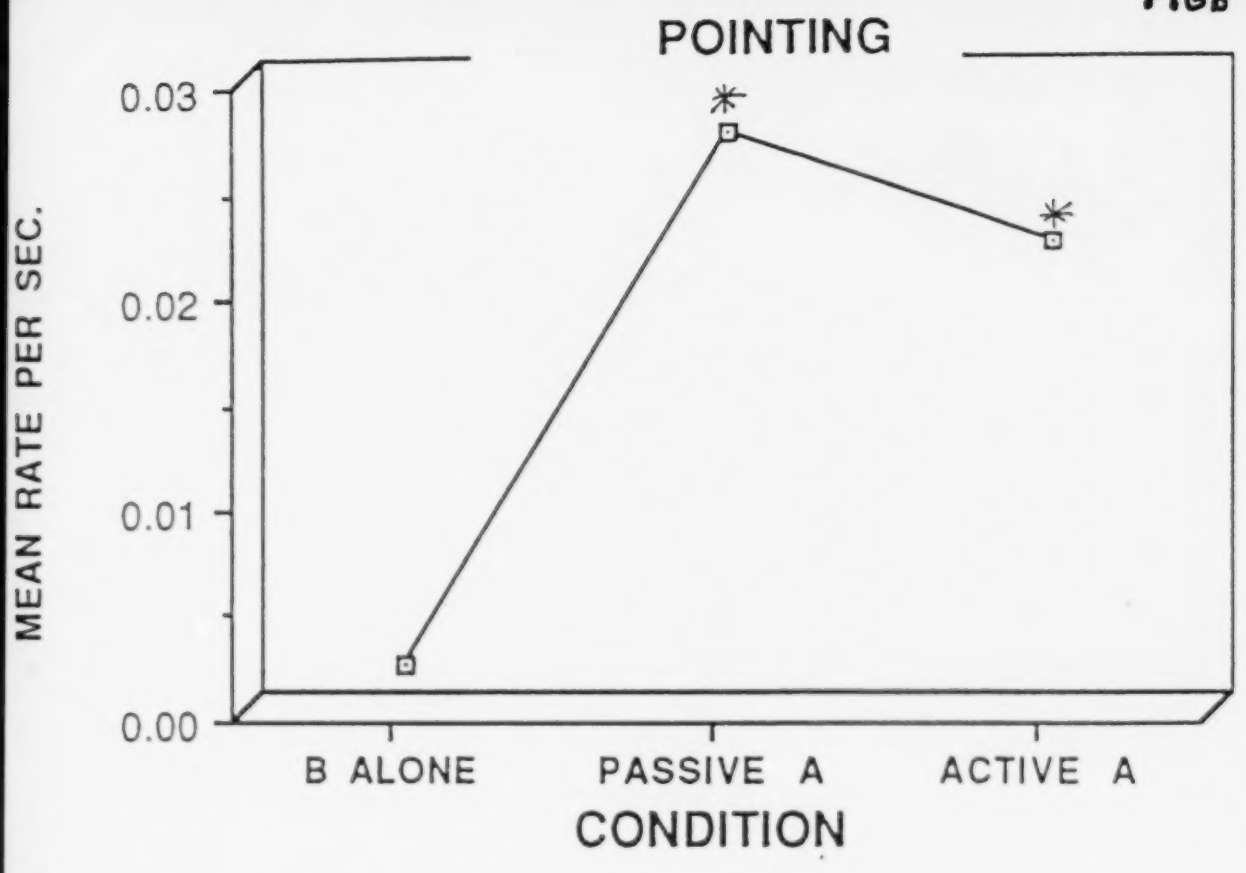

MULTIPLE CHECKING
PROPORTION
0.25
0.20
0.15
0.10
0.05
0.00
0.035
0.039
0.088
0.0404
0.162
0.197
0.037
pointing
reaching
1 2
1 4
1 6
1 8
age

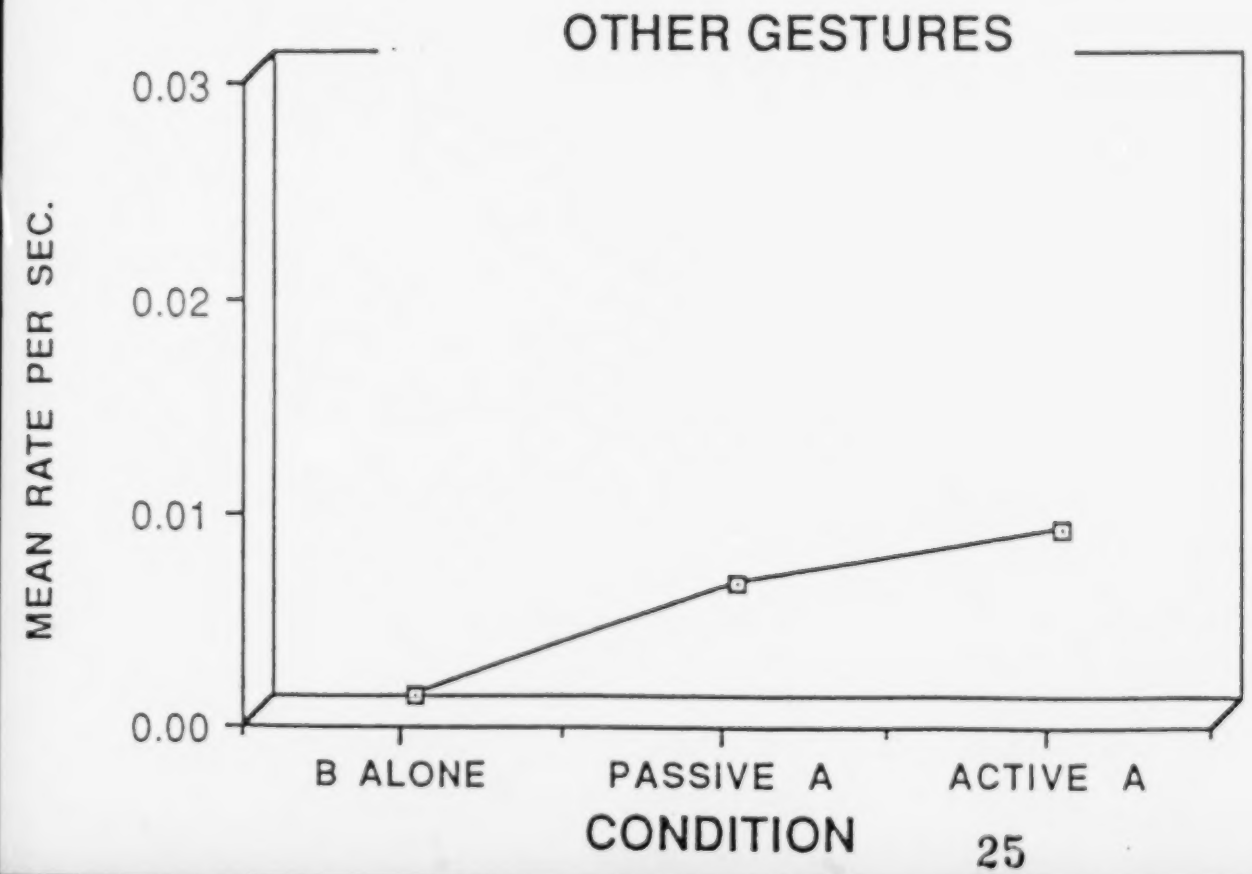
FIG 7

POINTING GESTURE ORIENTATION:
AGE x ORIENTATION $p < .04$



FIGS 8&9


POINTING
MEAN RATE PER SEC.
0.03
0.02
0.01
0.00
B ALONE
PASSIVE A
ACTIVE A
CONDITION


OTHER GESTURES
MEAN RATE PER SEC.
0.03
0.02
0.01
0.00
B ALONE
PASSIVE A
ACTIVE A
CONDITION

FIGs. 10, 11

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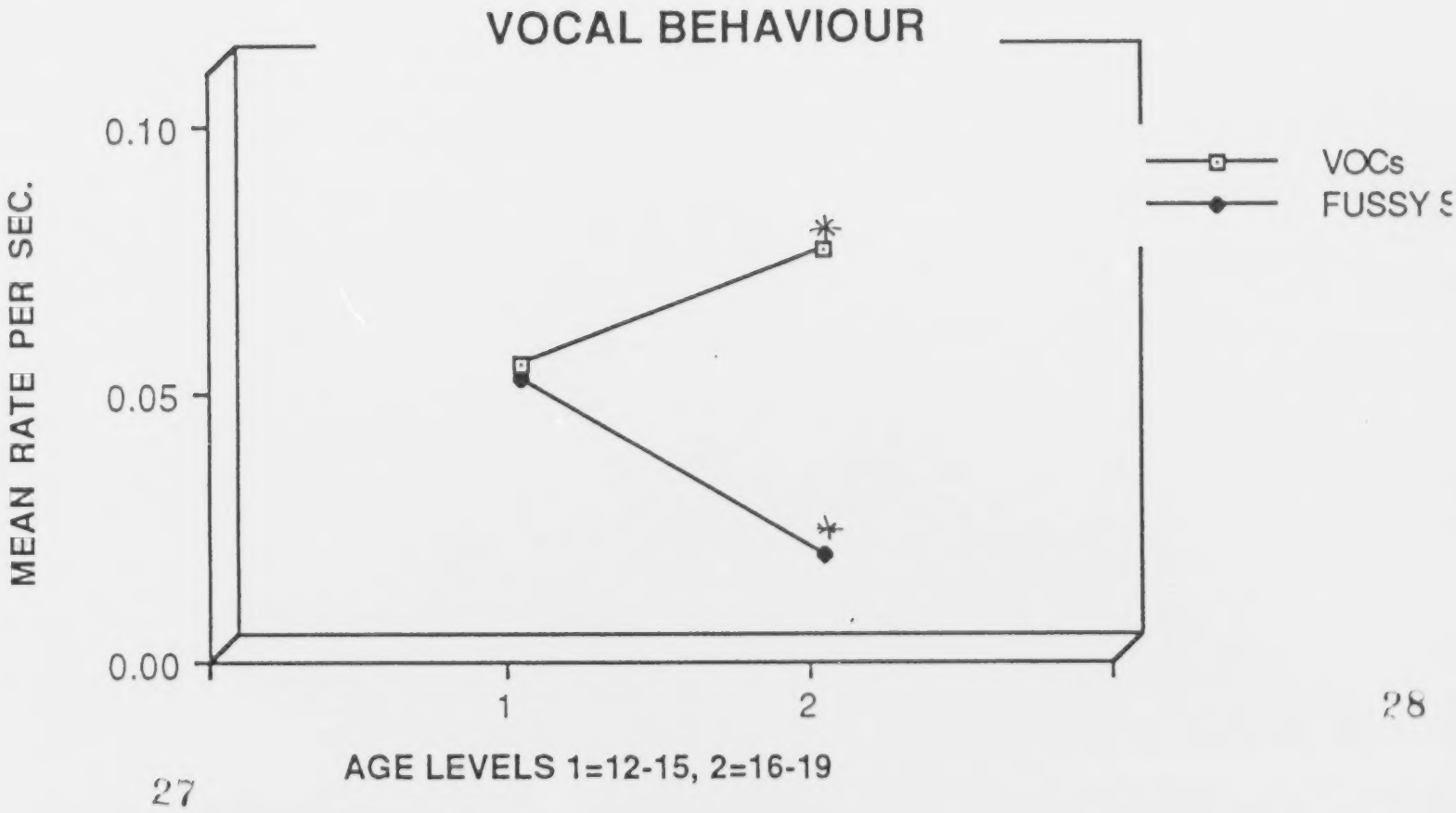
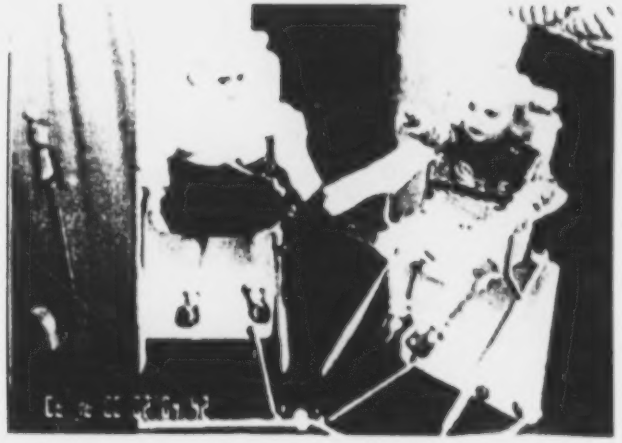
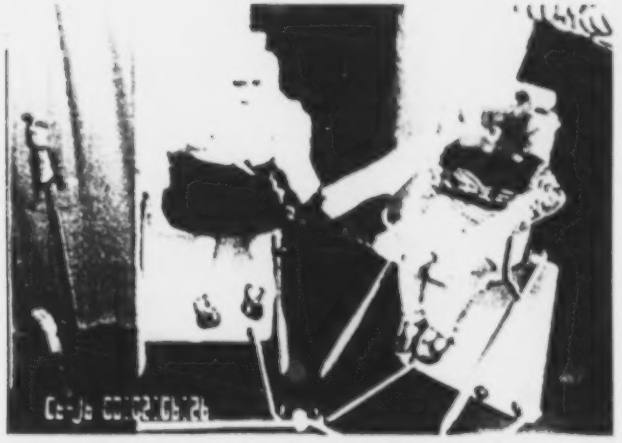
FIG. 12


VOCAL BEHAVIOUR
MEAN RATE PER SEC.
0.10
0.05
0.00
1
2
AGE LEVELS 1=12-15, 2=16-19
VOCs
FUSSY S

A



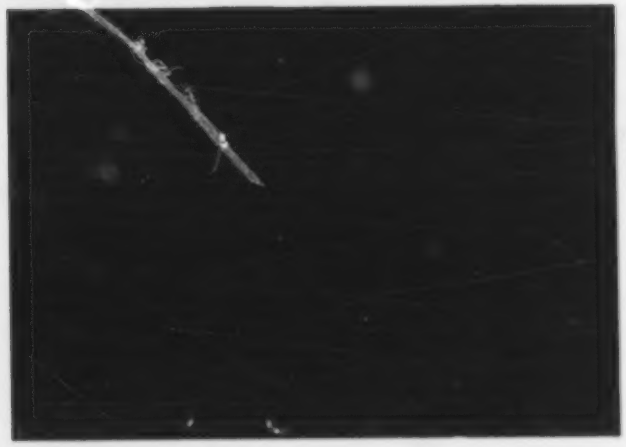
1.



2.

B

1.



2.

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Fig. 13, 14